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$$P_r = A_r \frac{|m|}{|r| |m-r|} \dots\dots\dots (2)$$

when A_r is known.

Let E_r = the mathematical expectation of coincidence, or the *probability* of an arrangement containing any assigned number of coincidences as $m - r$, multiplied by the number of coincidences. Then will

$$E_r = (m - r) P_r \dots\dots\dots (3).$$

Now the total expectation of coincidence will be a summation of all the terms E_r from $r = 0$ to $r = m - 1$ inclusive. Call this total expectation, or probable amount of coincidence, C . Then

$$\begin{aligned} C &= \sum_{r=0}^{m-1} E_r = \sum_{r=0}^{m-1} (m-r) P_r = \sum_{r=0}^{m-1} \frac{(m-r) A_r}{|r| |m-r|} \\ &= \sum_{r=0}^{m-1} \frac{A_r}{|r| |m-1-r|} = \frac{1}{|m-1|} \sum_{r=0}^{m-1} \frac{A_r |m-1|}{|r| |m-1-r|} = \frac{|m-1|}{|m-1|} [\text{by (1)}] \\ &= 1. \end{aligned}$$



PROBLEMS.

30. BY OTIS SHEPARD, GOODLAND, IND.—Prove that

$$\frac{\sqrt[4]{a} + \sqrt[4]{b}}{\sqrt[4]{a} - \sqrt[4]{b}} = \frac{a + b + 2\sqrt[4]{a^3 b} + 2\sqrt[4]{a b^3}}{a - b}.$$

31. BY PROF. D. KIRKWOOD, BLOOMINGTON, IND.—Solve the equation

$$x = \sqrt[4]{x + \frac{x}{\sqrt[4]{x + \frac{x}{\sqrt[4]{x + \dots}}}}}$$

and express the value of x in a finite number of terms.

32. BY PROF. D. TROWBRIDGE, WATERBURGH, N. Y.—There are two spheres of equal size and of exactly the same appearance, one solid

†In order that we may obtain the probable number of coincidences *in each independent allotment* the sum, C , must be divided by the number of permutations, $|m|$; . .

$$\frac{C}{|m|} = \frac{1}{|m|} \sum_{r=0}^{m-1} E_r = \frac{1}{|m|} \sum_{r=0}^{m-1} (m-r) P_r = \sum_{r=0}^{m-1} \frac{(m-r) A_r}{|r| |m-r|} \text{—ED.}$$

silver and galvanized with gold, the other hollow and made of gold. Required some means by which one may be determined from the other.

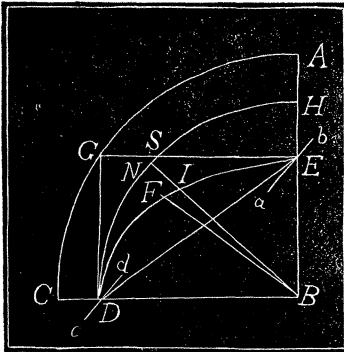
33. BY PROF. W. W. JOHNSON, ST. JOHN'S COLLEGE, ANNAPOLIS, MD.—A circle is referred to rectangular axes passing through its centre. A tangent and ordinate are drawn from any point of the circumference. A distance n times the abscissa of this point is measured upon the axis of x , and from this point a perpendicular falls upon the tangent. Required the equation of the locus of the intersection of the perpendicular and tangent.

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### SOLUTION OF A QUESTION IN MECHANICS.

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BY DR. J. B. HOLCOMB, NEWPORT, N. Y.



$AB$  and  $CB$  are two equal lines perpendicular to each other, and  $DE$  equal to either is inserted between them. Two equal and perfectly elastic balls fall from  $A$  and  $C$  towards a force at  $B$ , which force varies as the distance from  $B$ . At  $D$  and  $E$  the balls are deflected by planes  $cd$  and  $ab$  inclined at an angle of  $45^\circ$  to  $AB$  and  $CB$ .

What will become of the balls?

Will they ever meet, and if so where?

After such meeting, if it should happen, what will become of them then?

SOLUTION.

There may be two cases :

1. When the balls are deflected at  $E$  and  $D$  at the same instant.
2. When they begin their motion at  $A$  and  $C$  at the same instant.

For the 1st describe on  $EB$  and  $BD$  as semi-axes the quadrant of an ellipse  $DFE$ . Bisect the area  $DFE$  by the line  $BF$ , then the two balls will meet in the elliptic arc at the point  $F$ .

For the line  $DE$  which joins the extremities of the two axes of the ellipse, being equal to either of the lines  $AB$  and  $CB$  is a measure of the force which either of the balls would have acquired in falling from